MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

EME1076 – APPLIED DYNAMICS

(ME)

8 JULY 2023

9.00 a.m.– 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 7 pages including the cover page.
2. Choose FOUR out of FIVE questions to answer.
3. The distribution of the marks for each question is given.
4. Please write all your answers in the answer booklet provided. All necessary workings **MUST** be shown.

Question 1

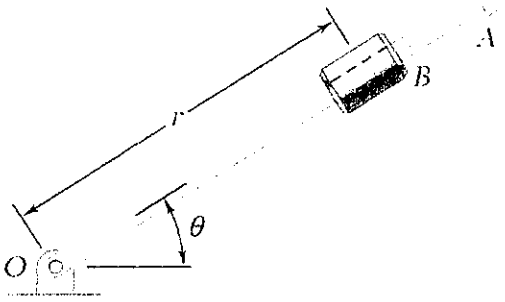

Figure 1

a) Rotation of the radially slotted arm is governed by $r = \sqrt{4sin\left(\frac{\theta}{2}\right)}$

Simultaneously, the power screw in the arm engages the slider B and controls its distance from O. In the other words, when the slotted arm moves in angular motion, the slider B is able to move along the axis *OA*.

Arm OA rotates counterclockwise with a constant angular velocity of $\theta = 2$ rad/s, determine the magnitudes of the velocity and acceleration of the slider B at $\theta = 30°$.

i) velocity(v_r and v_θ)

ii) acceleration(a_r and a_θ) [7 + 6 marks]

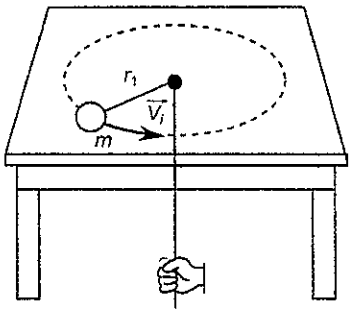

Figure 2

b) A 2-kg object is moving in a circular path of radius $r = 0.6$ m at a speed of $v = 5$ m/s. The object is connected to a cord and is being pulled down through a hole on a flat surface. The cord move down at a constant velocity of $v_r = 4$ m/s. Determine,

i) the velocity of the object when the radius r is reduced to 0.5m [6 marks]

ii) the work done to pull down the cord. [7 marks]

Question 2

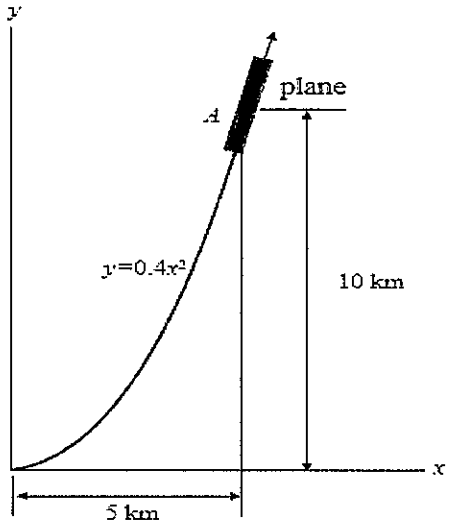

Figure 3

a) The jet plane travels along the vertical parabolic path. When it is at point A it has a speed of 200 m/s which is increasing at the rate of 0.8 m/s^2 . Determine the magnitude of the acceleration of the plane when it is at point A. Given the radius of curvature

$$\rho = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\frac{d^2y}{dx^2}}$$ [12 marks]

Continued...

b) Given a block with a mass of 5 kg, moving at a velocity of 4 m/s downwards, and located 10 meters above the sandy surface.

i) Calculate the impulse exerted by the sand on the block required to bring it to a complete stop. [6 marks]

ii) Calculate the mean force of the impulse applied by the sand on the block, given that the block's motion is arrested within 0.8 seconds after making contact with the sand. [7 marks]

Disregard any deformation of the sand due to the block and assume that the block does not bounce back.

Question 3

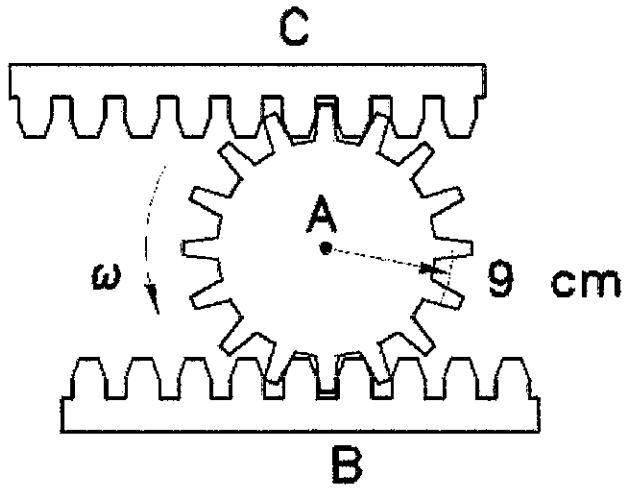

Figure 4

a) If the gear racks move in opposite directions, with B moving to the right and C moving to the left, the pinion gear will roll accordingly. In the system above, B moves to the right with 8 cm/s while C moves to the left with 4 cm/s. Determine,

i) the angular velocity of the pinion gear [7 marks]

ii) the velocity of its center A. [6 marks]

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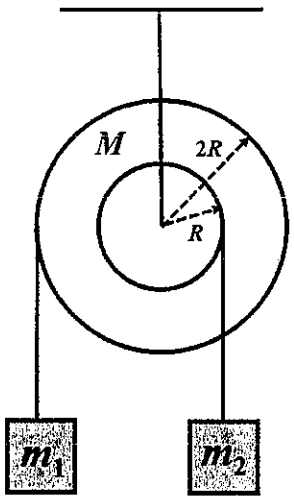

Figure 5

b) The dual pulley setup is comprised of two interconnected components, with a total mass of 25kg and a radius of gyration of 0.24m around its center. Assuming that neither cable slips on the pulley, and the system is rotating with an angular velocity of 18 rad/s in an anticlockwise direction, determine the kinetic energy of the system. The mass of object m_1 and m_2 are 8 kg and 12 kg respectively. Given also R = 0.2m.

[12 marks]

Question 4

a) A 3-kg block is suspended from a spring having a stiffness of k = 200 N/m.

i) Determine the equation that describes the motion if the block is pushed 40 mm upward from its equilibrium position and then released from rest.

ii) What are the amplitude and the natural frequency of the vibration?

Assume that positive displacement is downward. [9 + 4 marks]

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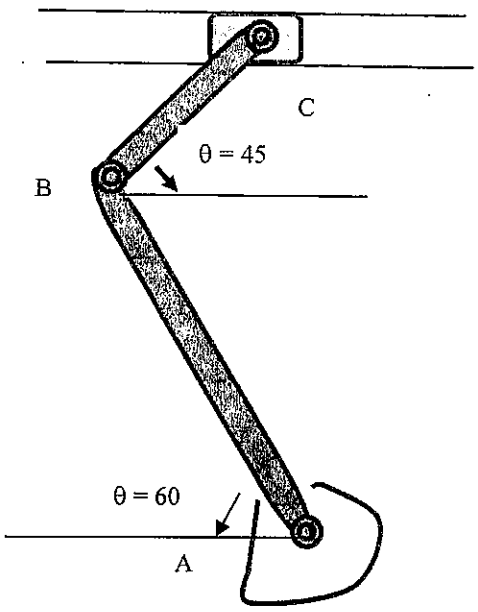

Figure 6

b) At a given moment, the shaper mechanism is arranged to deliver a slow cutting motion and a rapid return motion to a blade connected to the slider at point C. The length of AB and BC are 250 mm and 125 mm respectively. Link AB rotate in clockwise direction with 4 rad/s.

i) Draw the kinetic diagram, and label the instantaneous velocity. [3 marks]

ii) If the rotational speed of the link AB is 4 rad/s, determine the angular velocity of the link CB at the same moment. [9 marks]

Continued...

Question 5

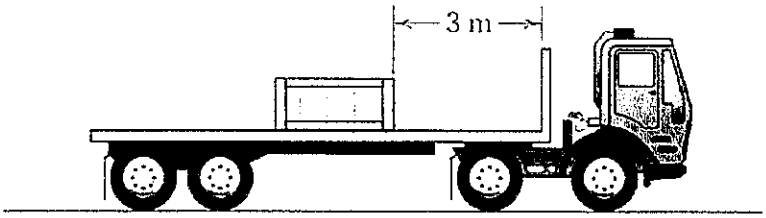

Figure 7

a) The truck in Figure 7 comes to a stop from an initial forward speed of 70 km/h in a distance of 50 m with uniform deceleration. The coefficient of friction between the flat bed of the truck and the crate it carries is 0.30. Determine

i) the stopping distance if the crate does not to slip forward.

ii) the acceleration of the crate relative to the truck.

[6 + 7 marks]

b)

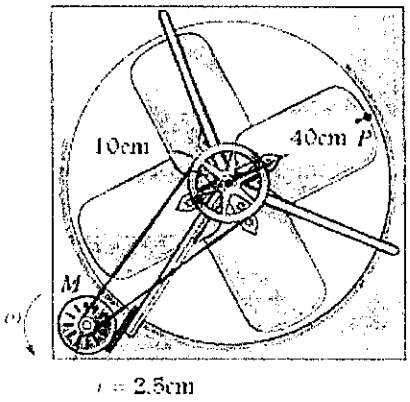

Figure 8

The motor M begins rotating at $\omega = 4(1 - e^{-t})$ rad/s, where t is in seconds. The radii of the motor, fan pulleys, and fan blades are 2.5 cm, 20 cm, and 40 cm respectively.

Determine the magnitudes of the velocity and acceleration at point P on the fan blade when $t = 0.5$ s. [12 marks]

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